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BUILDING MONITORING SYSTEM FOR LOW POWER WIRELESS SENSOR NETWORK

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Abstract:
Analysis of the stability of the building is a needed measurement process for all buildings in the cities. Periodic monitoring of the structure for such damage is therefore a key step in rationally planning the maintenance needed to guarantee an adequate level of safety and serviceability. However, in order for the installation of a permanently installed sensing system in buildings to be economically viable, the sensor modules must be wireless to reduce installation costs, must operate with a low power consumption to reduce servicing costs of replacing batteries, and use low cost sensors that can be mass produced such as MEMS sensors.

Keywords – Periodic monitoring, MEMS, sensors.

1. INTRODUCTION

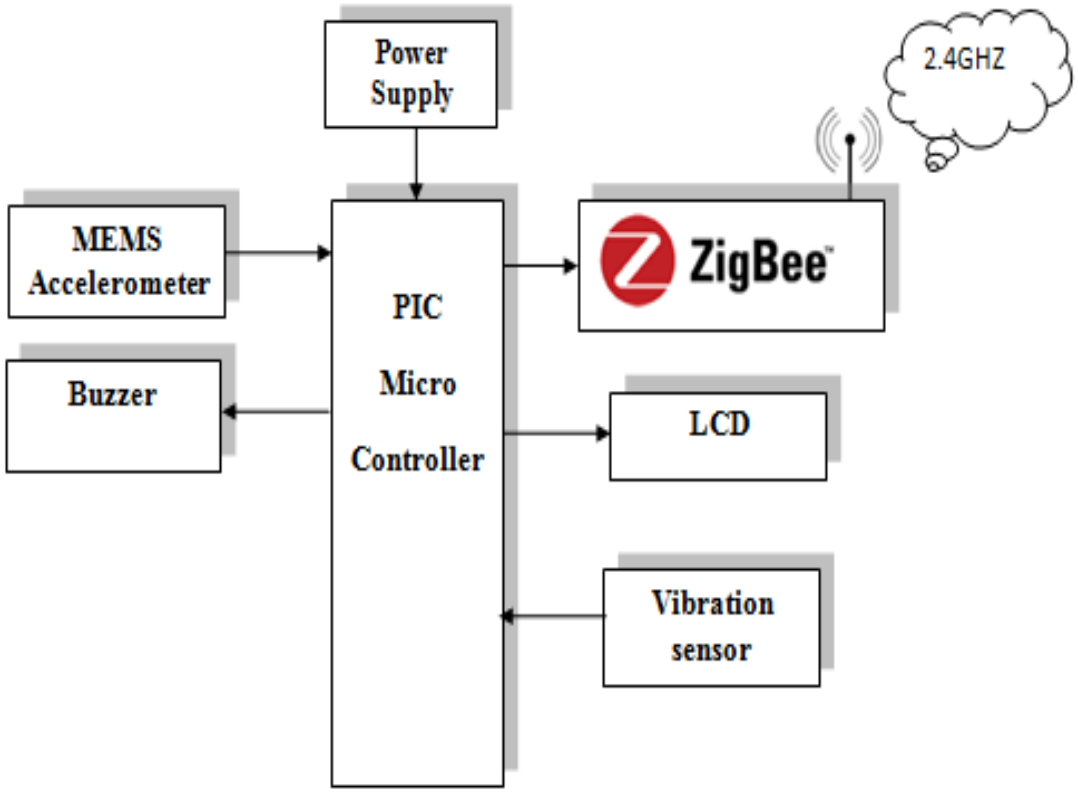

Fig.1.Block diagram

Interrupt is the signal sent to the micro to mark the event that requires immediate attention. Interrupt is "requesting" the processor to stop to perform the current program and to "make time" to execute a special code. In fact, the method of interrupt defines the option to transfer the information generated by internal or external systems inside the micro by them self! Once the system has finished the task imposed on it, the processor will be notified that it can access and receive the information and use it. The principle of power generation behind the solar cells consists of the utilization of the photovoltaic effect of semiconductors. When such a cell is exposed to light, electron-hole pairs are generated in proportion to the intensity of the light. Solar cells are made by bonding together p-type and n-type semiconductors. The negatively charged electrons move to the n-type semiconductor while the positively charged holes move to the p-type semiconductor. They collect at both electrodes to form a potential. When the two electrodes are connected by a wire, a current flows and the electric power thus generated can be transferred to an outside application.

2. PROPOSED METHOD

In existing system, manpower is used to monitor the stability of the building. Difficult to monitor continuously. Therefore we go to the proposed system. Difficult to find the damage in the building. Manual error may occur. We can design a new system to monitor the construction building stability using wireless technology. The monitoring information is send to the pc using zigbee .Low cost. Simple method to monitor continuously. High flexibility . A power supply unit (PSU) converts mains AC to low-voltage regulated DC power for the internal components of a computer. Modern personal computers universally use a switched-mode power supply. Some power supplies have a manual selector for input voltage, while others automatically adapt to the supply voltage. PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems. Micro-Electro-Mechanical Systems, or MEMS, is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of micro fabrication. The critical physical dimensions of MEMS devices can vary from well below one micron on the lower end of the dimensional spectrum, all the way to several millimeters. Likewise, the types of MEMS devices can vary from relatively simple structures having no moving elements, to extremely complex electromechanical systems with multiple moving elements under the control of integrated microelectronics.

3. METHODOLOGY

In this project we have MEMS accelerometer to sense the shaking of the building and vibration sensor is use to sense the vibration. All the data's sends to the microcontroller which in turn sends to the monitoring section through Zigbee wireless technology. Here we have three sections, the two floor sections has PIC microcontroller, Zigbee device and MEMS accelerometer and vibration sensor.

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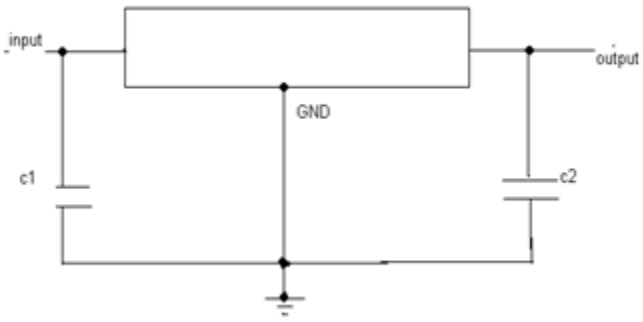
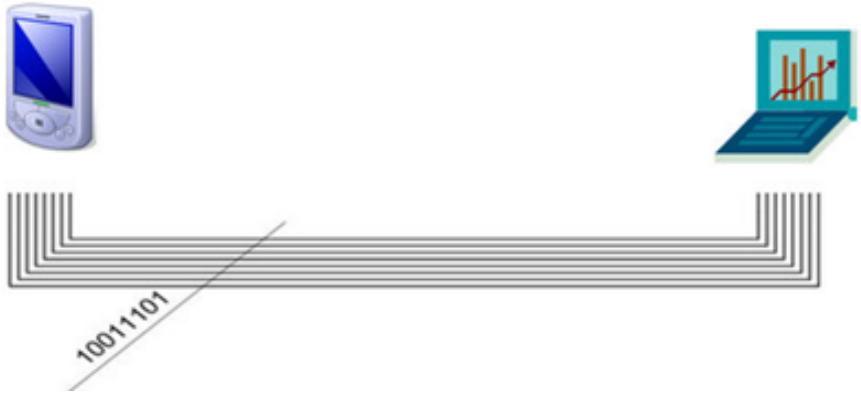


Fig.2. Supply circuit

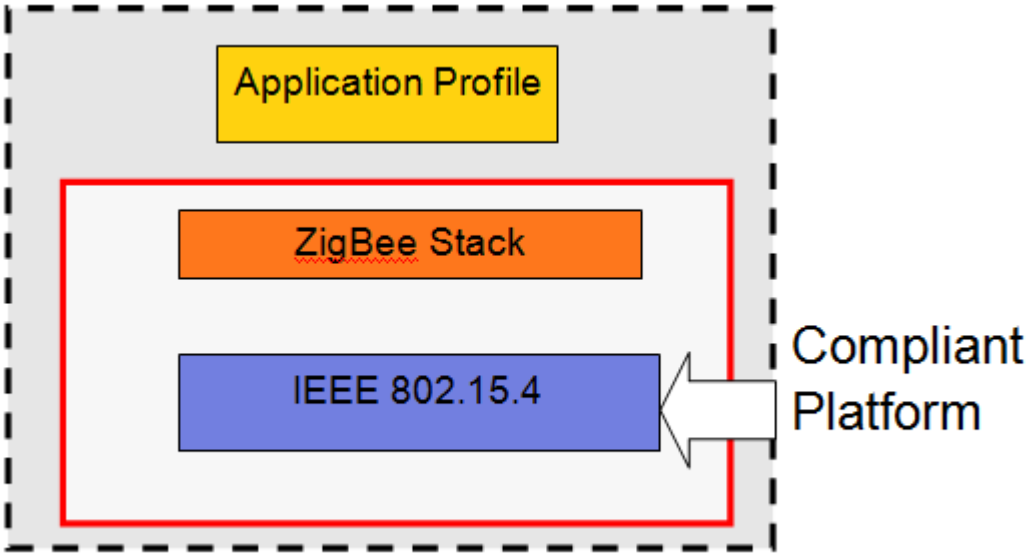
The monitoring section has PC and a Zigbee wireless device, which will collect the data from the floor sections and analyze the stability of the building. If the earthquake level is high, buzzer will make sound for alerting. A diode bridge is an arrangement of four diodes connected in a bridge circuit. That provides the polarity of output voltage of any polarity of the input voltage. When used in its most common application, for conversion of alternating current (A.C) input into direct current (D.C) output, it is known as a bridge rectifier. The diagram describes a diode-bridge design known as a full wave rectifier. This



Fg.3.Port communication

design can be used to rectify single phase A.C. when no transformer center tap is available. A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full wave rectification. This is a Widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally. Regulator regulates the output voltage to a specific value. The output voltage is maintained irrespective of the fluctuations in the input dc voltage. Whenever there are any ac voltage fluctuations, the dc voltage also changes, and to avoid this regulators are used.

4. ZIGBEE PLATFORM



Fg.4.Zigbee platform

ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range.The ZigBee Alliance, the standards body that defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. The technology is intended to be simpler and less expensive than other WPANs such as Bluetooth. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60K and 128K flash memory, such as the Jennic JN5148, the Freescale MC13213, the Ember EM250 and the Texas Instruments CC2430. Radios are also available stand-alone to be used with any processor or microcontroller. Generally, the chip vendors also offer the ZigBee software stack, although independent ones are also available.Because Zigbee can activate (go from sleep to active mode) in 15 msec or less, the latency can be very low and devices can be very responsive — particularly compared to Bluetooth wake-up delays, which are typically around three seconds. Because Zigbees can sleep most of the time, average power consumption can be very low, resulting in long battery life.The first stack release is now called *Zigbee 2004*. The second stack release is called *Zigbee 2006*, and mainly replaces the MSG/KVP structure used in 2004 with a "cluster library". The 2004 stack is now more or less obsolete. *Zigbee 2007*, now the current stack release, contains two stack profiles, stack profile 1 (simply called ZigBee), for home and light commercial use, and stack profile 2 (called ZigBee Pro). ZigBee Pro offers more features, such as multi-casting, many-to-one routing and high security with Symmetric-Key Key Exchange (SKKE), while ZigBee (stack profile 1) offers a smaller footprint in RAM and flash. Both offer full mesh networking and work with all ZigBee application profiles.

5. RESULT ANALYSIS

Identity	CO	NO2	SO2	PM
	µg/m3	µg/m3	µg/m3	µg/m3
2/23/2015 0:00	1.55	20.49	10.39	37.31
2/23/2015 1:00	1.36	20.14	9.49	23.65
2/23/2014 2:00	1.47	21.39	9.46	16.83
2/23/2015 3:00	1.71	20.95	10.12	13.41
2/23/2015 4:00	1.87	20.64	11.24	11.7
2/23/2015 5:00	1.83	21.44	11.49	61.8
2/23/2015 6:00	1.78	20.57	11.78	57.28
2/23/2015 7:00	1.98	20.95	11.39	33.64
2/23/2015 8:00	1.89	20.55	9.81	39.86
2/23/2015 9:00	1.75	20.8	9.97	51.44
2/23/2015 10:00	1.82	20.85	9.41	35.15
2/23/2015 11:00	1.81	20.74	9.55	74.77
2/23/2015 12:00	1.56	20.66	10.38	68.02
2/23/2015 13:00	1.75	21.07	10.49	45.56
2/23/2015 14:00	1.41	20.52	10.47	38.21
2/23/2015 15:00	1.7	20.48	10.65	43.94
2/23/2015 16:00	1.28	21.04	10.39	42.35
2/23/2015 17:00	1.64	21	10.38	57.94
2/23/2015 18:00	1.74	21.42	11.17	57.31
2/23/2015 19:00	1.71	20.61	13.02	42.7
2/23/2015 20:00	1.93	20.46	9.29	53.69
2/23/2015 21:00	1.83	21.06	9.71	61.82
2/23/2015 22:00	1.91	21.12	10.21	59.72
2/23/2015 23:00	1.59	20.8	9.6	62.94
2/24/2015 0:00	1.14	20.47	10.9	46.6

Fig.5.Analysis report

After system testing, the system was kept under observation in the field for a span of one week. The system was operated in the field for sensing the data and sending the sensed data to the master and master to the serial monitor via GPRS. The data observed in serial monitor was retrieved to the excel sheet. The below figure-1 show the air pollutant data which is sensed by slave module and sent to master module and was retrieved to excel sheet from serial monitor. EMC optimization was carried out and system was tested for operating in the field with Electro-Magnetic compatibility. The figure-3&4 give us the details of EMC optimization of air pollution monitoring system and the filters which were added to the system for EMC.

CONCLUSION

A wireless sensor network for air pollution monitoring system was successfully established in the field and the air pollution data was obtained as shown in figure 1. The sensors used are low cost sensors and provide us low resolution data but that data is enough to provide warning to public. The major issue with air pollution monitoring system is its life time. The low power wireless sensor network for air pollution monitoring system is very important in current day scenario and hence low power operation was implemented to the system for its real time monitoring with the battery life time of two years. The system was successfully calculated to operate in the field for two years. For a system to operate in the environment with lot of RF and EMI and other noises like electromagnetic spark plug emission, the system has to be added with filters like CM choke, and capacitance filters etc.

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